Chapter 1

The COMX 80-Column Card User Manual

This video card offers you the following features :

1. The 80 Character columns by 24 character lines are displayed at any one time.

2. Text is printed in upper and/or lower case at your discretion.

3. Full ASCII character support.

4. All text character entry is done directly using the COMX keyboard.

5. True cursor display and control is provided.

6. The video card is compatible with the COMX BASIC. You will not need any software modification when using the video card.

7. High character display rate.

8. Shift lock and inverse character display are supported.

9. BASIC now accepts lower case letter input. Upper and/or lower case letter can now be displayed at one time by the BASIC print statements.

10. This video card provides advanced display control features for advanced system programmer in system display enhancement projects.

Chapter 2

The COMX 80-Column Card User Guide

2.1 Peripherals Needed and Installation

2.1.1 Peripheras Needed

To use the video card you need the followings :

1. A COMX personal computer

2. The video card

3. A television set or

4. A composite video input monochromatic monitor

2.1.2 Installation

1. Using the 80-Column Card with the COMX Expansion Box.

(a) Plug the video card into any expansion slot.

(b) Connect the monitor cable into the RCA jack of the video card or in case you have a TV, connect the TV cable.

(c) Power on your COMX personal computer.

(d) Your monitor now shows a screen with interference.

(e) Type "card sn", where n is the slot number you select.

(f) The monitor now should show a clear display with the word "ready" at the top left hand corner of your monitor display. The computer will be ready for use.

(h) If your monitor shows no display or remains to have a screen with interference, power off your computer and check all your installation procedures and repeat from step (c) again.

(i) If your video card is still not working, you should consult our authorized agent in your area.

2. User without the COMX Expansion Box

(a) Plug the card in the COMX expansion slot at your computer's right edge.

(b) Connect the monitor cable into the RCA jack in your video card.

(c) Power on your computer.

(d) Your monitor now shows a screen with interference.

(e) Type "call (@CØ1Ø)".

(f) Your monitor now should show a clear display with the word "ready" at the left top corner of your monitor display.

(g) If your monitor shows no display or remains to have a screen with interference, power off your computer and check your installation again and repeat from step (c) again.

(h) If your video card still not working, you should consult our authorized agents.

2.2 Features and Operation Procedures

2.2.1 Text can now be input and printed in upper and/or lower cases. The system fully supports the full ASCII character set.

2.2.2 Shift lock mode is entered by pressing Control-L. All lower case letter will be changed to upper case and vice versa. Other non-alphabetic key function remains unchange. To go back to the other mode, press your control-L again.

2.2.3 Home return is done by pressing Control-H. The whole screen display is cleared and cursor is moved to the top left hand corner of the monitor display.

2.2.4 Inverse display mode is supported after pressing Control-B. All new letter display will now be in dark character with bright background. Press Control-B again to quit.

2.2.5 A built-in self test can be called by the user by pressing Control-T.

2.2.6 To go from 80-column display to 40-column display, the user can press Control-Q.

2.2.7 The Reset key should not be pressed, otherwise control will be passed back to 40-coloumn output again.

Chapter 3

Hardware Reference Manual

Figure 1 is the block diagram of the video card. Figure 2 is the schematic diagram.

The heart of the video card is the central large chip MC6845 CRT controller. This chip generates all the video output timing signal : Horizontal SYNC, Vertical SYNC, cursor signal and Display Enable.

The 14.31818MHZ crystal and the two inverters forms a high frequency oscillator which gives the dot clock for the output shift register U10. The U13 binary counter and a three input NAND forms a divide-by-7 counter. This counter divides the dot clock by 7 to give the character clock. The output of the NAND gate gives the load pulse for the output shift register to load in the output dot data. The character clock is used by the CRTC and U8, a 8-bit latch, to latch character ASCII code output from the screen memory. This output ASCII code is then used as character generator pointer to address the character generator U. The output of the character generator is loaded into an 8-bit parallel load serial shift register U10. The dot data output is then shifted out as video data.

U11 is a latch chip. It provides the necessary delay of the display enable signal and cursor signal from the CRTC. The output is then mixed with the shift register video output by those AND and EXOR gates. The final video output to the monitor is given by the output transistor.

U1, a five bit latch and U2, a three-to-eight multiplexer forms the address decoding block of the card.

The firmware of the video card is stored in the ROM U3. The decoded address of this chip is $C000 to $C7FF.

The screen memory is in U7, a 2K bytes static RAM. The decoded address is $D000 to $D7FF. U4 to U6, three two-to-one multiplexers, form a multiplexer of the CRTC and CPU addresses to the screen memory. Notice that the CPU can only alter the screen memory content during the retrace period. These screen memory chips form a dual port RAM.

Chapter 4

Software Reference Manual

4.1 Use of CRTC

The heart of the video card is the large chip MC6845 programmable CRT controller. The CRTC contains a set of internal registers which are user software programmable. The physical address mapping of the CRTC is only two memory locations. One is the address register and the other is the data register. To program a particular internal register, you first store the desired register number (1 to 15) into the address register and then store the desired value into the data register.

The functions of the various internal registers are as follows :

4.1.1 Horizontal Displayed Register R1

This 8-bit write-only register determines the number of displayed characters per line.

4.1.2 Horizontal Sync Position Register R2

This 8-bit write only register controls the Horizontal Sync position. The horizontal sync position defines the horizontal sync delay (front porch).

4.1.3 Sync Width Register R3

This 8-bit write only register determines the width of the vertical sync pulse and the horizontal sync pulse.

4.1.4 Vertical Total Register R4

The frequency of the vertical sync is determined by this register and R5. This register, determines the integer number of character line.

4.1.5 Vertical Total Adjust Register R5

This register contains the fraction of character line times.

4.1.6 Vertical Displayed Register R6

This 7-bit write only register specifies the number of displayed character rows on the CRT screen and is programmed in character row times.

4.1.7 Vertical Sync Position R7

This 7-bit write only register controls the position of the vertical sync.

4.1.8 Interlace Mode R8

This register controls the raster scan mode interlace or noninterlace.

4.1.9 Maximum Scan Line Address Register R9

This 5-bit write only register determines the number of scan lines per character row including the spacing.

4.1.10 Cursor Start Register R10 and Cursor End Register R11

These two registers determine the shape of the cursor.

4.1.11 Start Address Register (R12-H, R13-L)

This 14-bit write only register pair controls the first address output by the CRTC after vertical blanking.

4.1.12 Cursor Register R14-H, R15-L

This 14-bit read/write register pair is programmed to position the cursor anywhere in the refresh RAM area.

4.2 Firmware Functions

The main task of the firmware is to initialise the video card and acts as a line editor so as to replace the original input editor.

BASIC gets input from the keyboard through a special routine called the input routine. The address of this input routine is stored into a special location called the input hook. The input hook is between $428A and $428D. In order to get the input control, the firmware changes the input hook content to $C0EA which is the new input routine address. All input are now handled by this new input routine. The routine will poll the keyboard location so as to get the input code from the keyboard. Then the input code will be transformed. The lower case letter code is transformed into upper case letter code and vice versa. The Special codes are also handled at this time. Other codes are passed to the old conversion routine of the old input routine for special conversion. Code are then stored into the screen memory located between $D000 and $D7FF. Codes can only be stored into the screen memory at retrace period of the display. Through hardware design, EF4 will reset during the retrace period. So the firmware will poll this flag until it is reset, the codes will then be stored into the screen memory after all the codes have been passed to the BASIC interpeter.

Beside the input routine, we also need a output routine. This routine will display all the output information from the BASIC. Like the input routine, the address of the output routine is stored into the location called output hook from $428E to $4292. The firmware now changes the content of the hook to hold $C1BC which is the address of the new output routine. This routine will receive code from BASIC. The code is stored in the high byte of RF. The routine first transforms the upper case letter codes to lower case letter codes and vice versa. Special codes are also handled at this time. Displayable codes are then stored into the screen memory.

4.4 Firmware System Parameter

4.4.1 CRTCA $D800

This location holds the pointer of the CRTC register.

4.4.2 CRTCD $D801

This location is the CRTC data register.

4.4.3 SPACES $B000

This location acts as the space counter of the editor. Its value is the cursor displacement from the carriage return position.

4.4.4 LCOUNT $B001

This location is the line counter. It holds the number of line displacement from the top.

4.4.5 CURHI and CURLO $B001,$B002

This two location holds the cursor displacement from the home address.

4.4.6 CAP $B004

This is the shift lock flag.

4.4.7 REVERSE $B005

This is the inverse display flag.

4.5 Registers Used in the Firmware

4.5.1 Low Byte of RB

It holds the line count.

4.5.2 Low Byte of RE

It holds the spaces count.

4.5.3 RC

It holds the cursor displacement.

4.5.4 High Byte of RF

It holds character codes.

4.5.5 RA

It holds the physical screen memory address of the next character position.

Chapter 5

General Specifications

5.1 Screen display format : 80 character X 24 row

5.2 Character matrix : 8 dot X 8 row

5.3 Character set : standard ASCII

5.4 Display mode : Normal and inverse

5.5 Supply current : 480 mA at 5 volt DC